

ADHESIVE BONDING FOR AUTOMOTIVE APPLICATIONS
DOE's Lightweight Vehicle Materials Program

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In 1992, the Oak Ridge National Laboratory (ORNL) began a cooperative effort with the Automotive Composites Consortium (ACC) to develop technologies to overcome hurdles in adhesive bonding of current and future automotive materials. This effort is part of a larger Department of Energy (DOE) program to promote the use of lighter weight materials in automotive structures. By reducing the weight of current automobiles, greater fuel conservation and reduced environmental pollutant emissions will be achieved. The bonding of similar and dissimilar materials was identified as being of primary importance to the automotive industry because it is an enabling technology allowing designers the freedom to choose from a wide variety of low mass materials, including composites.

The technical goals for the adhesive bonding initiative have been defined by the automotive industry. The comprehensive effort addresses the following research areas of importance: bulk material characterization, structural fracture mechanics, modeling/characterization, process control and non-destructive evaluation, and advanced processing.

The goal of the bulk material characterization effort is to determine the individual material properties of the adherends and adhesives. This includes generating a data base of mechanical and physical properties and identifying and developing standard test methods to obtain properties. Test development for determining fracture toughness for adhesive joints includes Mode I, Mode II and mixed-mode methods. Test procedures for quantifying an adhesive/adherend system's resistance to crack growth will be standardized and automated for use by industry. The modeling/characterization study will allow optimization of adhesively bonded joint design, without extensive testing, by developing predictive methodology. Fracture mechanics based guidelines have been developed and transferred to the ACC Joining Group. Methods of non-destructive evaluation of adhesive bonds which can be used for process optimization, in-line process control and product validation are currently being evaluated. The advanced processing task is intended to investigate mechanisms for increasing the manufacturability and reducing the costs of bonded composites. Several alternate processing methods have been demonstrated which significantly reduce the cure time and improve the adhesion.

The adhesive bonding program is being executed by industry, university and government researchers and is managed jointly by the ACC Joining Group and ORNL staff members. Plans for extension of this research program to meet future needs include evaluating effects of environmental exposure, developing fatigue and creep test methods and continuing investigation in rapid-cure and surface preparation technologies.

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